Oracle’s Core Diameter Routing Solution
Tools to Grow Your All Internet Protocol Network
With mobile traffic exploding, Long Term Evolution (LTE) and IP Multimedia Subsystem (IMS) networks are on the rise. Oracle’s core Diameter routing solution provides the controls and visibility organizations need to build and grow them.

By the end of 2011, the number of mobile phone subscribers had reached more than 6 billion, according to a report by the International Telecommunication Union. In addition, machine-to-machine communications, smart cars, and other objects are connecting to and using mobile networks in increasing numbers. To accommodate this dramatic escalation in mobile traffic, more and more organizations are migrating to all Internet Protocol (IP) LTE and IMS networks.

These networks—and the voice, data, video, and machine communications they support—all require the exchange of authentication, charging, quality of service (QoS), and mobility information between network elements for each voice, data, video, and multimedia communication. In IP networks, Diameter signaling is used for this information exchange, taking over the role that Signaling System No. 7 (SS7) performed in legacy networks. Diameter signaling is used between many Electronic Product Code (EPC) and IMS elements for the exchange of subscriber and device data.

Due to the number of elements and the volume of messages that exist today, service providers face complex Diameter signaling environments. Route management and interoperability in the extensive mesh of Diameter connections can have a negative impact on network scalability. Network growth and manageability are already being hampered by the explosion of Diameter traffic dealing with third-generation (3G) mobile data and charging—and that volume of messages will grow even more with the addition of LTE and Voice over LTE.

Diameter controls are thus essential for organizations that want to build and monetize their networks to capitalize on IP evolution. Service providers need a central control point for Diameter messages in their network. Diameter signaling controllers can provide it—streamlining operations, facilitating scalability, enabling rapid interoperability, and ensuring network resilience. Oracle’s core Diameter routing solution offers such a solution.
Challenges to Implementing Core Diameter Routing

As a key signaling protocol for 3G, LTE, and IMS networks, Diameter handles a substantial volume of messages. It also presents several management challenges.

**Limited Scalability**

The volume of messages and Diameter transactions for authentication, mobility, and updates as well as for each voice or data session can be huge. The processing load on Diameter elements can impact the ability to scale individual elements and the network.

**Overload and Network Failure**

The servers processing various authentication, QoS, and charging functions are not equipped to deal with spikes in volume. This can impact service quality and availability.

**Complex Provisioning and Routing**

Given the number of elements, their location, and how they must interconnect, programming route tables and routing messages can be challenging. And as the network grows, the tasks of provisioning, maintaining, and changing them can become daunting. As a result, operational costs increase and network growth is impeded.

**Multivendor Interoperability**

Although Diameter is a standard, numerous interpretations of it have arisen as IMS and LTE have evolved and more vendors have entered the market. In addition, network differences (such as transport protocol or IP version) can cause incompatibility and transaction failures. Multivendor environments can cause interoperability problems that add extra time and costs to the initial deployment and ongoing operations. What’s more, this lack of interoperability limits choice for service providers.

**Lack of Visibility**

As the number of vendors and elements grows and the volume of transactions increases, collecting and correlating the information from all these messages becomes a formidable if not impossible task. Yet, the information contained in these messages is critical for network planning, troubleshooting, and daily operations.

To overcome these challenges, service providers use Diameter signaling controllers (DSCs) to provide critical congestion control, mediation, and routing functions for Diameter signaling. These functions reduce costs, streamline networks, and ensure resilience for LTE and IMS networks. DSCs are deployed in the Evolved Packet Core (EPC) or IMS data center, ideally situated as the central hub to meet all core Diameter routing requirements.
Core Diameter Routing Solution Overview

Oracle’s core Diameter routing solution provides critical overload control, interoperability, routing, load balancing, and reporting functions for Diameter signaling, enabling the network to cost-effectively scale. Featuring Oracle’s Acme Packet Net-Net Diameter Director, Net-Net Central, and Palladion management software, this solution is designed for 3G, LTE, and IMS service providers.

Net-Net Diameter Director is a Diameter agent that supports relay, redirect, and proxy modes and provides an intermediary control function for Diameter transactions. It also meets two key Third Generation Partnership Project (3GPP) functional requirements in IMS/LTE networks:

- **Diameter routing agent (DRA).** Provides enhanced routing and session binding in a multiple Policy and Charging Rules Function (PCRF) environment.
- **Subscriber location function (SLF).** Selects the appropriate Home Subscriber Server (HSS) for a given subscriber based on profile information.

Net-Net Diameter Director encompasses the full set of relevant Diameter profiles, interfaces, and use cases. The major Diameter interfaces are shown in the table.

<table>
<thead>
<tr>
<th>Application</th>
<th>Server Node</th>
<th>Client Node</th>
<th>Interface/Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G/LTE subscriber authentication and mobility</td>
<td>HSS</td>
<td>MME</td>
<td>Cx, Dh, Dx, S6a</td>
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<tr>
<td></td>
<td>HSS</td>
<td>SGSN</td>
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<td></td>
<td>HSS</td>
<td>AS</td>
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<td></td>
<td>HSS</td>
<td>CSCF</td>
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<td></td>
<td>SLF</td>
<td>AS/CSCF</td>
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<tr>
<td>Online and offline charging</td>
<td>OCS</td>
<td>Application server</td>
<td>Gy, Gz</td>
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<td></td>
<td>OCS</td>
<td>CSCF and SBC</td>
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<tr>
<td></td>
<td>OCS/OFCS</td>
<td>GGSN and PDN-Gateway</td>
<td>Rf, Ro</td>
</tr>
<tr>
<td>QoS and bandwidth reservation</td>
<td>PCRF</td>
<td>CSCF and SBC</td>
<td>Gx, Rx, Sd, Sy</td>
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<tr>
<td></td>
<td>PCRF</td>
<td>GGSN and PDN-Gateway</td>
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<tr>
<td>FMC subscriber authentication</td>
<td>AAA</td>
<td>PDG and ePDG</td>
<td>S6b, Wm</td>
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<td>AAA</td>
<td>Security Gateway</td>
<td>Wm, Wm/SWm</td>
</tr>
<tr>
<td></td>
<td>AAA</td>
<td>PDN-Gateway</td>
<td></td>
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</tbody>
</table>

Figure 1. Diameter mesh in LTE.

Figure 2. Net-Net Diameter Director streamlines the network.
Oracle’s core Diameter routing solution goes beyond these functional definitions to provide a comprehensive set of proxy, routing, and control functions for all authentication, authorization, and accounting (AAA); charging; and QoS policy exchanges in 3G, LTE, and IMS networks.

Net-Net Diameter Director cost-effectively scales, meeting a wide range of capacity and performance requirements. Net-Net Central—a fully integrated, extensible management system—provides provisioning and system-level data for Net-Net Diameter Director.

Palladion provides a real-time, networkwide dashboard view of network key performance indicators (KPIs), facilitating detailed transaction analysis.

Net-Net Diameter Director is also a core component of the LTE roaming solution. In addition to routing, aggregation, and interoperability functions, it provides a security demarcation point for LTE roaming relationships with mobile network operators, IP Exchanges, and roaming hubs.

Solution Features and Benefits

Oracle’s core Diameter routing solution takes advantage of the rich functionality of Net-Net OS to provide a comprehensive solution that serves many functional areas for service providers building 3G, LTE, and IMS networks. The benefits delivered by Net-Net Diameter Director include

- Streamlined, scalable network
- Lower total cost of ownership
- Improved network resilience
- Faster time to market
- Enhanced visibility and manageability

Congestion and Overload Control

In any IP network, critical resources can be overloaded and cause crippling service disruptions. To protect revenue-producing elements in the network, such as HSSs and PCRFs, Net-Net Diameter Director provides robust overload controls to ensure network availability. These include

- Dynamic signaling rate limiting—DSC self-protection and for core elements
- Congestion control and load balancing for core Diameter elements
- Removal of malformed Diameter messages
Comprehensive Interoperability

Net-Net Diameter Director provides a comprehensive set of interworking capabilities to ensure that a diverse array of elements from different vendors can interoperate. The normalization and mediation functionality accelerates time to market for the initial deployment as well as when vendors are added or code bases upgraded. This interworking capability also enables service providers to choose best-of-breed Diameter elements as opposed to being restricted to a single vendor.

Diameter Attribute Value Pairs (AVPs) can be modified, added, or removed based on specified criteria as messages flow through Net-Net Diameter Director. The solution’s Diameter manipulation functionality provides a powerful interoperability tool that does not depend on feature enhancements or software updates.

Layer 3 through layer 5 interworking and mediation functions include
- Diameter protocol mediation and normalization
- Diameter AVP and grouped AVP manipulations
- Diameter response code mapping
- TCP to Stream Control Transmission Protocol transport layer interworking
- Internet Protocol version 4 and version 6 interworking
- Diameter-MAP/SS7 interworking

Centralized and Intelligent Routing

Service providers require flexible routing policies to enforce complex business logic. Net-Net Diameter Director’s high-performance Diameter routing engine can route Diameter messages according to a variety of criteria. As the hub for all connections, Net-Net Diameter Director simplifies provisioning of new elements as the network grows. By provisioning and updating routing tables in a centralized Diameter agent, Net-Net Diameter Director eliminates the N-squared connected mesh, streamlining the process.

Key attributes of Net-Net Diameter Director’s routing engine include
- Hierarchical routing to support infrequent routing paths
- Session binding and load balancing for policy servers
- HSS address resolution and load balancing
- Failure detection and alternate route selection
Monitoring and Analysis

Net-Net Diameter Director aggregates all Diameter interfaces and messages, providing data for reporting and analyzing key network performance indicators. Working in conjunction with Net-Net Central or the Palladion service management and operations suite, network operators can fully track and debug issues and quickly perform root cause analysis.

These tools improve network visibility and enhance network planning and design through features such as

- Per-device and networkwide views
- Multivendor support
- KPI dashboards
- Detailed session analysis and real-time filtering
- Database front end for searching stored Diameter transactions
- Analysis of Diameter messages based on agent, content, time, and location

Conclusion

Prevalent in the next-generation IP networks supporting the $1 trillion mobile services market, Diameter is a core network protocol enabling subscriber authentication and service profile management, location and mobility management, QoS, and charging. To support the evolution to these new types of networks, service providers need to ensure that Diameter signaling can scale effectively in their network environments. With Oracle’s core Diameter routing solution, they can ensure it does—streamlining operations, facilitating scalability and interoperability, and ensuring network resilience in LTE and IMS networks.